



**Carnegie Mellon  
Software Engineering Institute**

---

Pittsburgh, PA 15213-3890

# **Integrating Software Architecture Evaluation in a DoD System Acquisition**

**John Bergey  
Timothy Morrow  
April 2005**

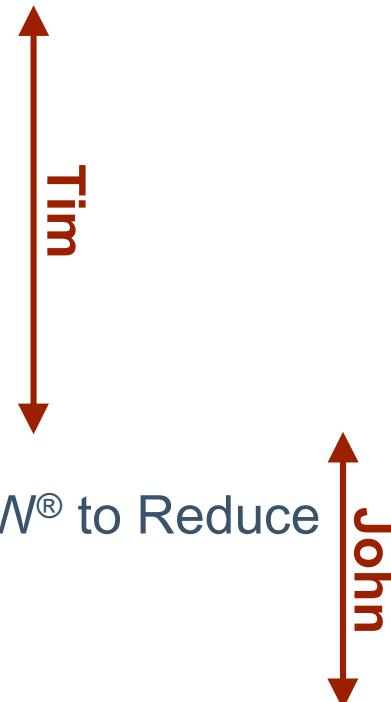
**Sponsored by the U.S. Department of Defense  
© 2005 by Carnegie Mellon University**

<b>Report Documentation Page</b>			Form Approved OMB No. 0704-0188	
<p>Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.</p>				
1. REPORT DATE <b>APR 2005</b>	2. REPORT TYPE	3. DATES COVERED <b>00-00-2005 to 00-00-2005</b>		
4. TITLE AND SUBTITLE <b>Integrating Software Architecture Evaluation in a DOD System Acquisition</b>			5a. CONTRACT NUMBER	
			5b. GRANT NUMBER	
			5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)			5d. PROJECT NUMBER	
			5e. TASK NUMBER	
			5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>Carnege Mellon University,Software Engineering Institute,5000 Forbes Avenue,Pittsburgh,PA,15213-3890</b>			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSOR/MONITOR'S ACRONYM(S)	
			11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release; distribution unlimited</b>				
13. SUPPLEMENTARY NOTES				
14. ABSTRACT				
15. SUBJECT TERMS				
16. SECURITY CLASSIFICATION OF:  a. REPORT      b. ABSTRACT      c. THIS PAGE <b>unclassified</b> <b>unclassified</b> <b>unclassified</b>			17. LIMITATION OF ABSTRACT <b>Same as Report (SAR)</b>	18. NUMBER OF PAGES <b>19</b>
				19a. NAME OF RESPONSIBLE PERSON

# Presentation Outline

- CLIP Program Background
- CLIP System and Software Concept
- CLIP Challenges
- Role of Architecture in RFP/contract
- Current Acquisition Status
- Proactive Application of ATAM® and QAW® to Reduce Software Acquisition Risk
- Impact of Work

® Architecture Tradeoff Analysis Method and ATAM and Quality Attribute Workshop (QAW) are registered in the U.S. Patent and Trademark Office by Carnegie Mellon University.



## Common Link Integration Processing (CLIP) – Background

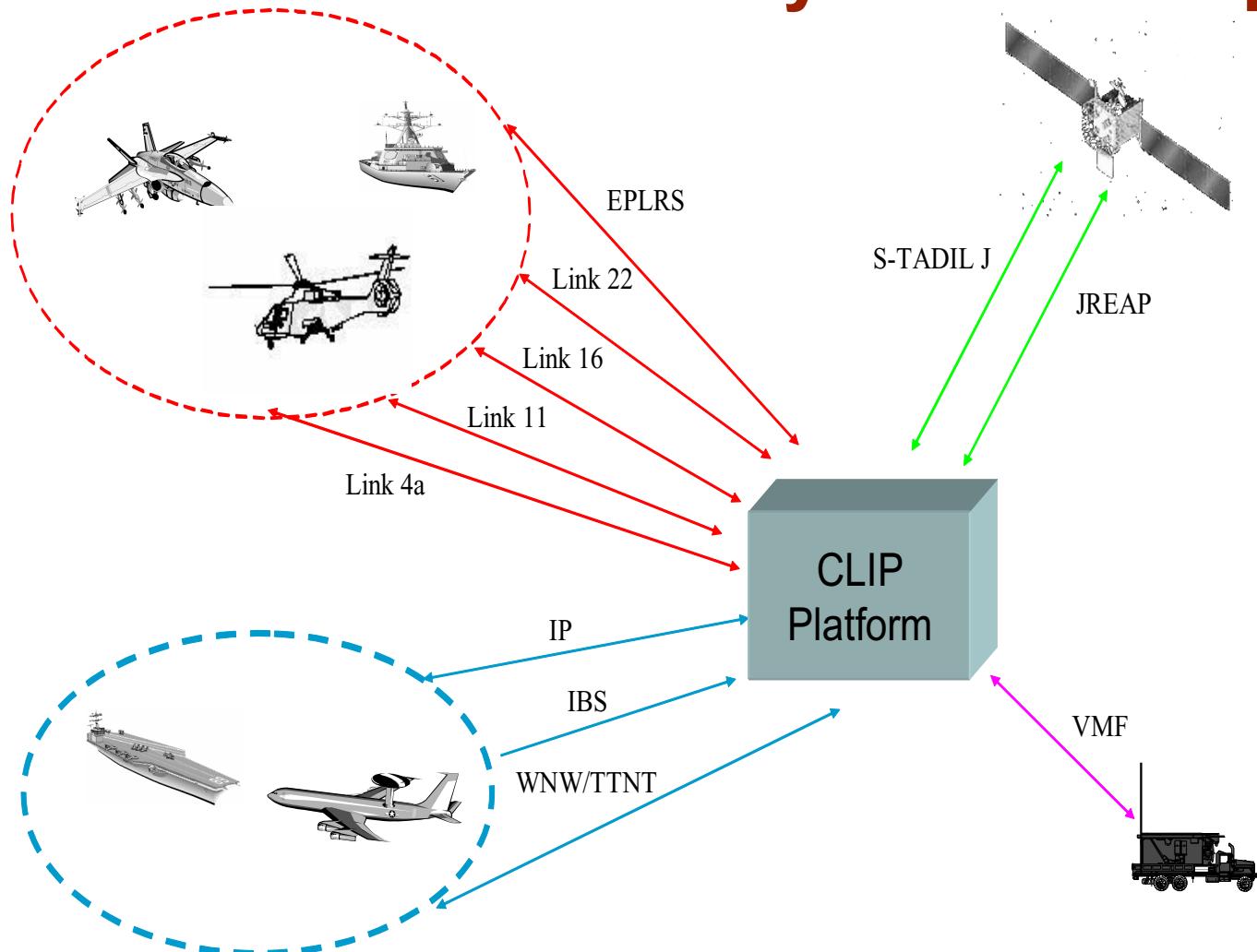
Cooperative Air Force/Navy program

- Integrate Tactical Data Links (TDLs) across platforms with a TDL requirement
- Provide message processing, gateway functionality, and a common interface
- Enable transition of new and legacy platforms to Network Centric Warfare (NCW) environment

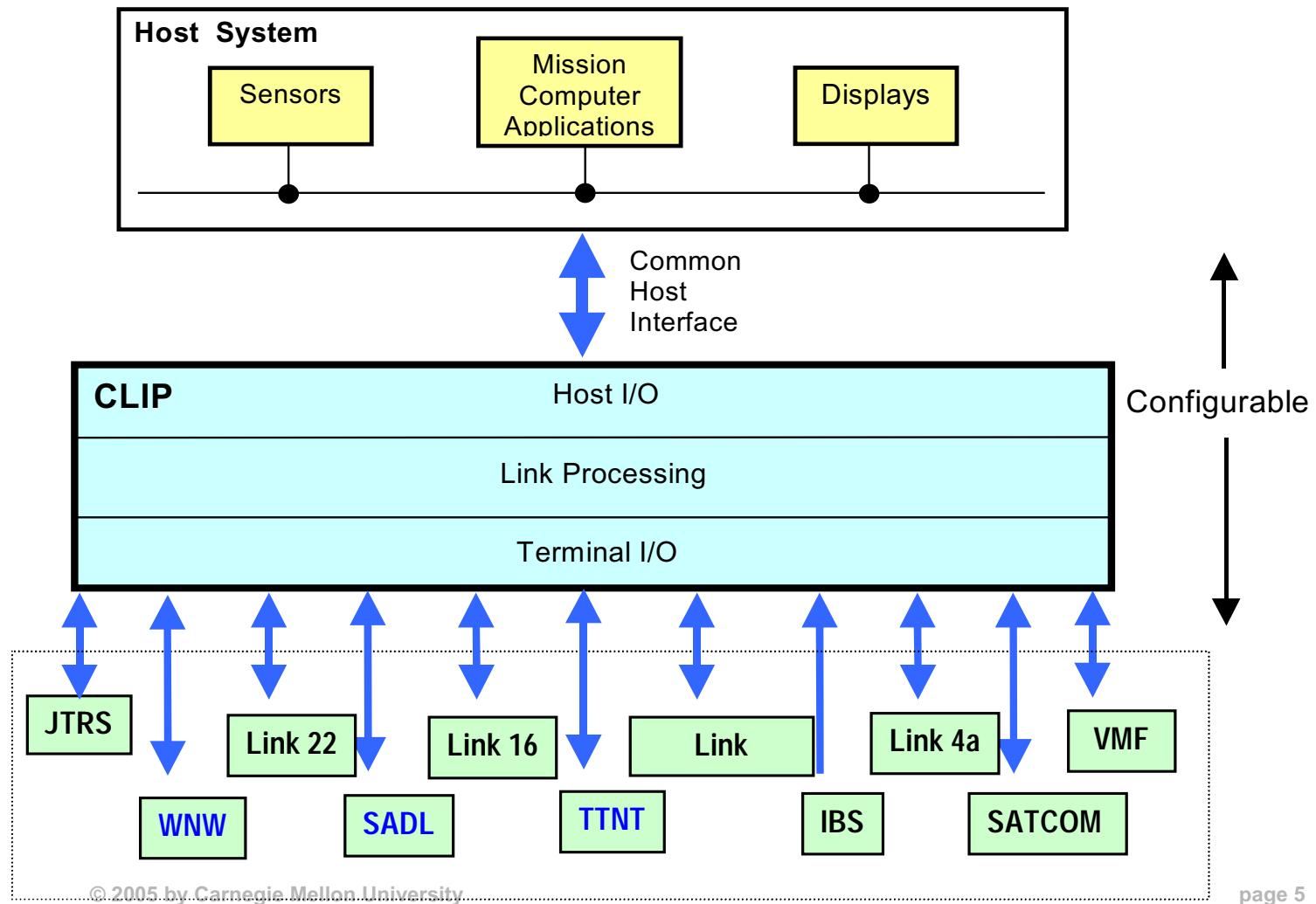


Carnegie Mellon  
Software Engineering Institute

# CLIP System Concept



# CLIP Software Concept

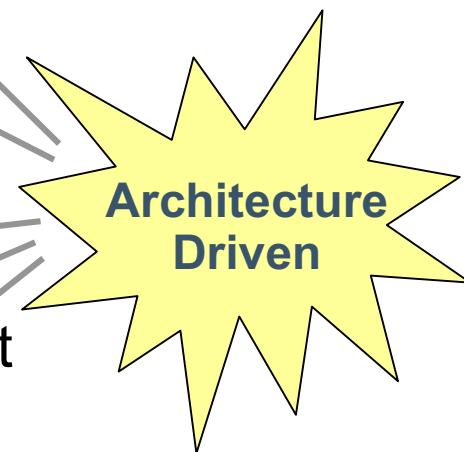


# Challenges

- Incremental acquisition supporting different platform integration need dates
- Developing software assets which will be portable to the different platforms using diverse hardware and software
- Ability to forward data “intelligently” from multiple TDLs
- Integration of CLIP with other DoD systems under development
- Development of a common host interface

## Key DoD 5000 Acquisition Documents

- Acquisition Strategy and Acquisition Plan
- System Engineering Plan
- Test and Evaluation Master Plan
- Request for Proposal
  - Statement of Work
  - System Requirements Document
  - Sections B, H, L, and M
  - CDRLs (Deliverables)
- Timeline to support acquisition milestones



## Current Acquisition Status

CLIP Contract:

- \$275 Meg\*
- In final phase of source selection
- Projected contract award: May 2005

Software architecture related contractual events:

- QAW to be conducted in July 2005
- Software architecture document to be delivered in support of Preliminary Design Review (PDR)
- First ATAM engagement in Nov 2005

\*Source: FCW.COM News Article:

<http://www.fcw.com/fcw/articles/2005/0207/web-comlink-02-08-05.asp>

# Use of QAW and ATAM to Reduce Software Acquisition Risk

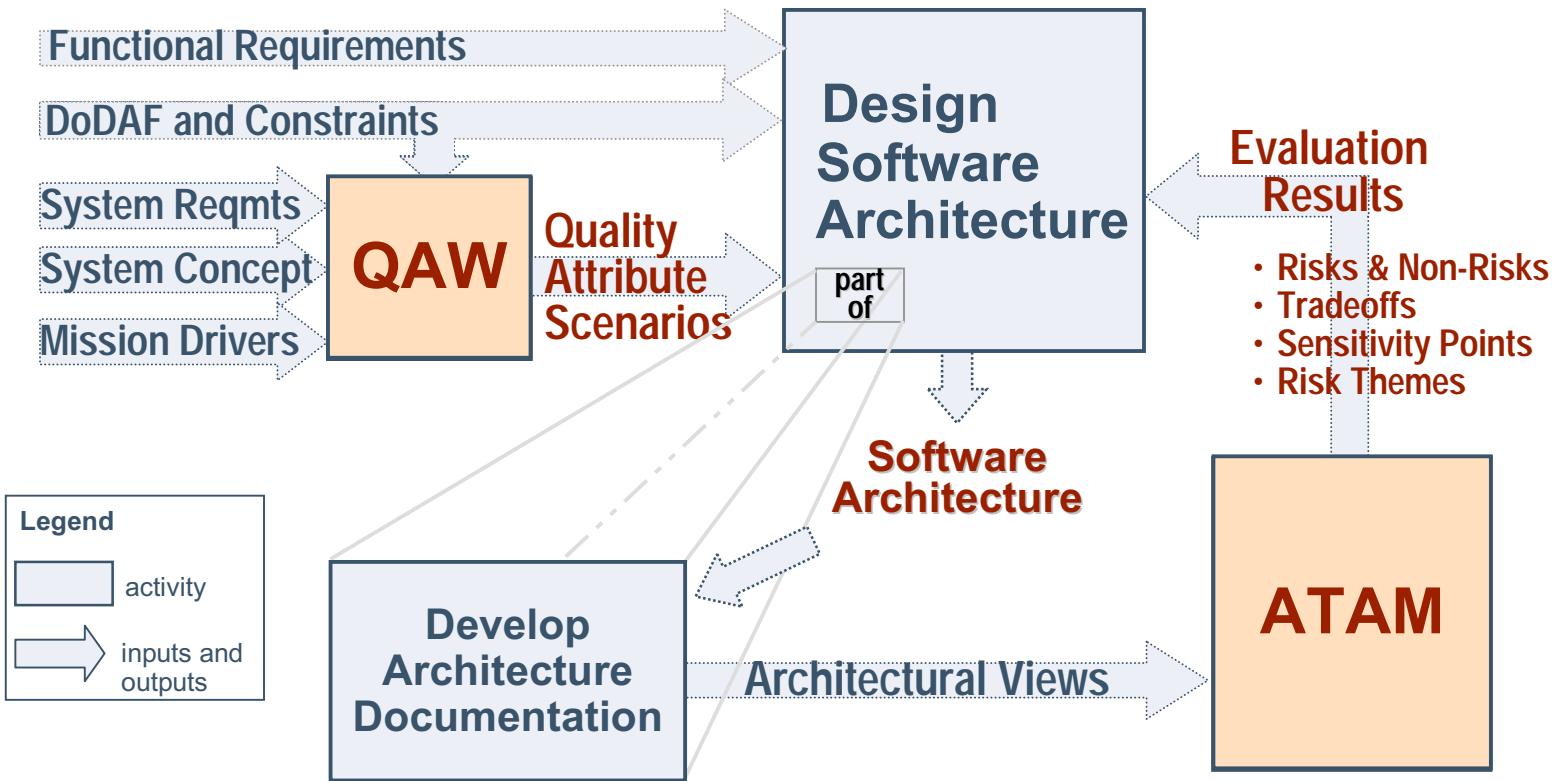
## QAW – Quality Attribute Workshop

- Provide a common forum for discussing quality attribute requirements and architectural implications
- Gain stakeholder buy-in

## ATAM – Architecture Tradeoff and Analysis Method

- Increase communication among stakeholders
- Clarify quality attribute requirements
- Identify software risks early in the development cycle
- Provide documented basis for architectural decisions

# “Big Picture” Development Context



Such a “big picture” view of a contractor’s architecture-centric development approach would be described in its Software Development Plan (SDP).

# Software Architecture Evaluation in an Acquisition Environment

Software architecture evaluation is especially critical when acquiring large, complex systems ...

but, conducting a software architecture evaluation in the DoD acquisition environment is more involved ...

- acquisition focus is on acquiring “systems”
- limited points of contact and leverage
  - exercised from a distance
  - occur at discrete points in the life cycle
  - governed by a stringent set of regulations
- lack of awareness that certain practices are permitted

# Approaches for Conducting ATAM-Based Evaluations

## Reactive

Software architecture evaluations are conducted *opportunistically* and performed *in situ* under an existing contract at the request of the program manager.<sup>1</sup>

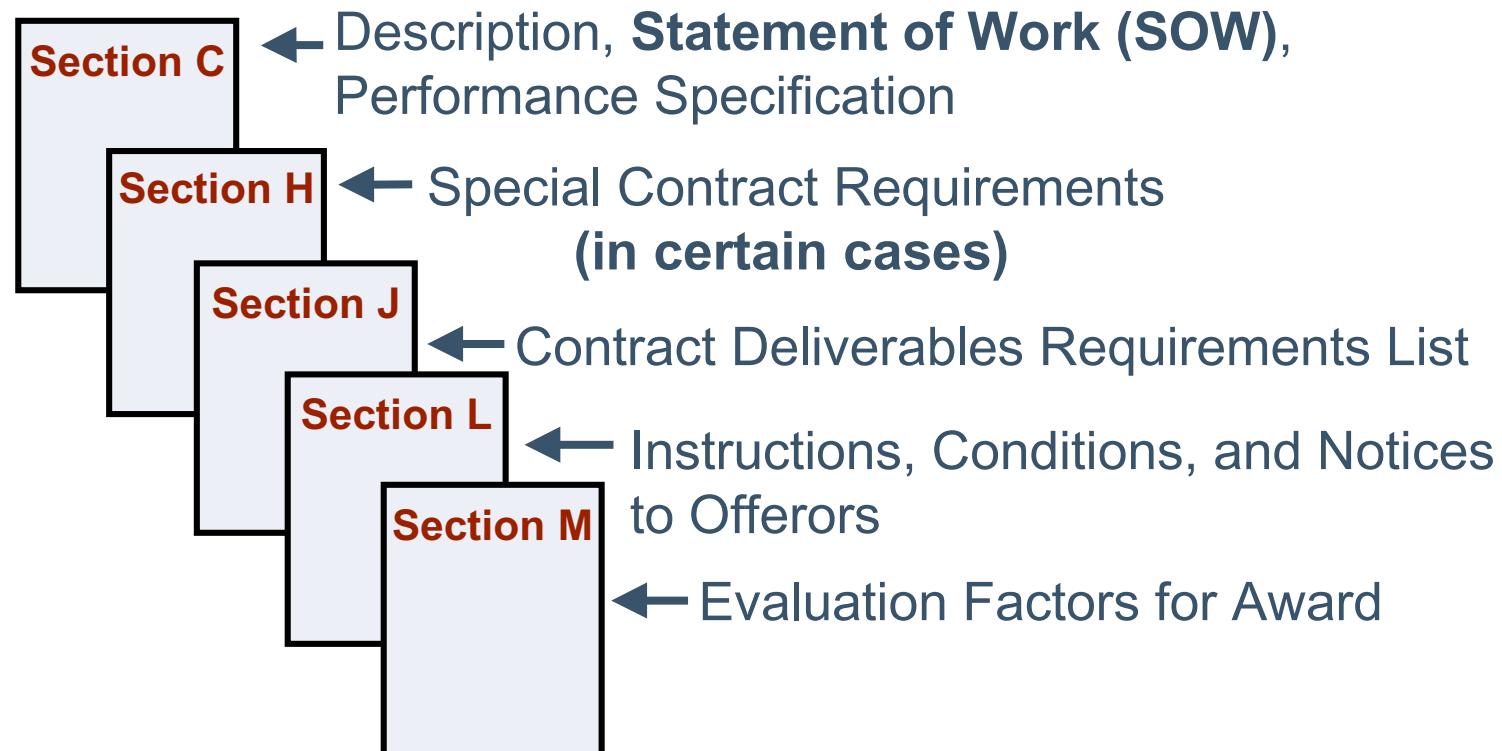
## Proactive

Software architecture evaluations are *preplanned* and integrated up front in a request for proposal (RFP) for a system (or software) acquisition.

<sup>1</sup> Or at the request of a contractor under a separate agreement

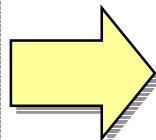
# Request for Proposal (RFP)

Incorporating architecture evaluations in an RFP requires developing appropriate language for the following sections:



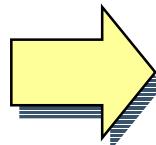
# Government Specifies the Method

**Section C  
of RFP  
Statement  
Of  
Work**



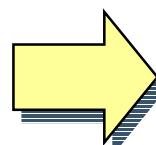
*“An evaluation team shall conduct a series of software architecture evaluations in accordance with the special requirements of Section H.”*

**Section H  
of RFP  
Special  
Contract  
Requirements**



Includes detailed requirements (comparable to a plan) specifying how the software architecture evaluations are to be conducted using the ATAM. **These constitute the software architecture evaluation requirements.**

**Section J  
of RFP  
Contract  
Deliverables  
Requirements  
List**



Identifies Associated Contract Deliverables

- Software Architecture Documentation
- Software Architecture Evaluation Report

# What Needs to be Specified?



The software architecture evaluation requirements must address

- What evaluation method is to be used and what are the steps?
- ➔ • Who are the participants in the architecture evaluation?
  - What are their roles and responsibilities?
- ➔ • How many evaluations need to be conducted and when?
- ➔ • If multiple evaluations are involved, how are they to be staged?
  - What are the prerequisites for conducting the evaluations?
  - What is involved in terms of time, effort, and cost?
- ➔ • How are evaluation team responsibilities to be transitioned?
  - How will the objectivity of the participants be ensured?
  - How are the evaluation results to be captured and used?
  - What contract deliverables need to be included?
  - How can the evaluations be carried out collaboratively to ensure both government and contractor stakeholders play an active role?
  - What training will be provided for the evaluation team members?
  - And the list goes on ...

Example  
on next  
slide

## Participants in the Initial Architecture Evaluation

CLIP Contractor's Software Development Cycle				
ATAM Participants	1st Architecture Evaluation (Increment/Spiral 1)			
ATAM Evaluation Team	SEI conducts full ATAM evaluation. <i>A contractor and program office representative may also attend as observers.</i>			
Project Decision Makers	Includes chief architect and other agents of contractor and program office			
Software Architecture Stakeholders (Only participate in Phase 2 of the ATAM)	Includes program office agents, contractor personnel, and representatives from organizations to be supported by Increment/Spiral 1			

\* External evaluators can be an agent of the government program office or an agent of the contractor organization; contractor agents, though, must be external to the project whose architecture is being evaluated.

## Example Staging & Transitioning of Responsibilities

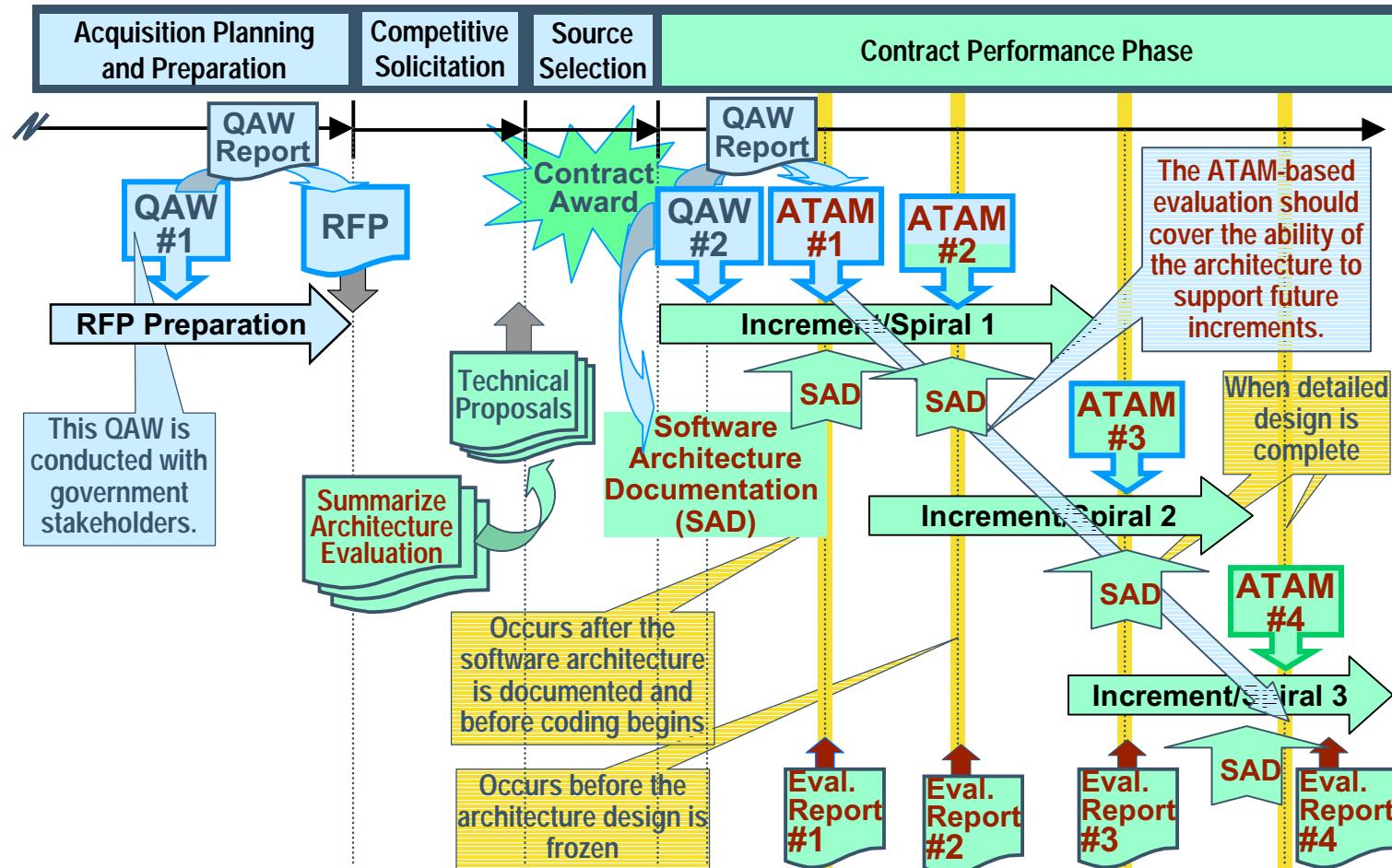
Contractor's Software Development Cycle				
ATAM Participants	1st Architecture Evaluation (Increment/Spiral 1)	2nd Architecture Evaluation (Increment/Spiral 1)	3rd Architecture Evaluation (Increment/Spiral 2)	Follow-On Evaluations (Increment/Spiral 3 to N)
<b>ATAM Evaluation Team</b>	SEI conducts full ATAM evaluation. A contractor and program office representative may also attend as observers.	SEI provides ATAM facilitation. Team consists of SEI lead evaluator, an SEI evaluator, and two or more external* ATAM evaluators.	SEI provides ATAM coaching only. Lead evaluator and other team members are all external* ATAM evaluators.	SEI is not involved. An all project team conducts evaluations. Lead evaluator and other team members are all external* ATAM evaluators.
<b>Project Decision Makers</b>	Includes chief architect and other agents of contractor and program office			
<b>Software Architecture Stakeholders</b> (Only participate in Phase 2 of the ATAM)	Includes program office agents, contractor personnel, and representatives from organizations to be supported by Increment/Spiral 1	Increment/Spiral 1	Increment/Spiral 2	Increment/Spiral 3toN

Alternatively,  
the architecture  
evaluations can  
be conducted by  
SEI ATAM-certified  
evaluators.

Full ATAM Adoption

\* External evaluators can be an agent of the government program office or an agent of the contractor organization; contractor agents, though, must be external to the project whose architecture is being evaluated.

# Coordinated Use of QAW and ATAM



## Impact

A QAW and ATAM-based evaluation have been successfully integrated into an RFP/contract for a major DoD acquisition.

The approach and RFP/contract language were approved by an independent assessment team and the CLIP contracting officer.

Based on the CLIP experience, we have developed  
*“Guidance for Reducing Software Acquisition Risk through Architecture Evaluation”*.

This guidance is available to DoD programs that want to promote architecture-centric development and proactively perform software architecture evaluation in their system acquisition.

The architecture evaluation approach and corresponding contract language and software deliverables will be described in a set of SEI Technical Notes.